What is claimed is:

1. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a complex data output device for performing a wavelet transform of received data and outputting complex data;

a delay element for delaying the complex data for one sampling period and outputting delayed complex data;

a complex divider for dividing the complex data and the delayed complex data, and for outputting divided complex data, wherein the divided complex data expresses a phase difference between complex subcarriers;

a phase-difference distribution calculator for calculating a number of the divided complex data present within each of plural quadrants on orthogonal coordinates and selecting a maximal number among the calculated numbers; and

a decision unit for deciding whether the received data is intended data by comparing the maximal number and a threshold number.

2. The receiving apparatus according to claim 1, wherein said complex data output device comprises:

a wavelet transformer including M real coefficient wavelet filters (M is a positive integer), which are orthogonal with respect to each other, for performing a wavelet transform

of the received data;

a complex data generator for generating complex data by defining (2n-1)th outputs (n is a positive integer) from said wavelet transformer as in-phase components of complex information and 2n-th outputs ($1 \leq n \leq (M/2 - 1)$ and subcarriers are numbered from 0 to M-1) from said wavelet transformer as orthogonal components of the complex information, and outputting parallel complex data; and

a parallel to serial converter for converting the parallel complex data output from said complex data generator to serial complex data and outputting the serial complex data.

3. The receiving apparatus according to claim 1, wherein said phase-difference distribution calculator comprises:

a shifter for shifting a phase of the divided complex data by $\pi/4$;

a sign decision unit for performing a decision of a sign of the divided complex data;

a plurality of counters for counting a number of divided complex data points distributed to each of the plural quadrants and outputting the counted numbers; and

a maximal number detector for detecting the maximal number among the counted numbers output from said plurality of counters.

4. The receiving apparatus according to claim 1, wherein said phase-difference distribution calculator comprises:

a sign decision unit for performing a decision of a sign of both in-phase components of the divided complex data and orthogonal components of the divided complex data;

a plurality of counters for counting a number of each of the signs output from said sign decision unit and outputting the counted numbers; and

a maximal number detector for detecting a maximal number among the counted numbers outputted from said plurality of counters.

5. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a complex data output device for performing a wavelet transform of received data and outputting complex data;

a delay element for delaying the complex data for one sampling period and outputting delayed complex data;

a complex divider for dividing the complex data and the delayed complex data, and for outputting divided complex data, wherein the divided complex data expresses a phase difference between complex subcarriers;

a phase-difference distribution calculator for calculating a number of the divided complex data present within

each of plural quadrants on orthogonal coordinates and selecting a maximal number among the calculated numbers;

a decision unit for deciding whether the received data is intended data by comparing the maximal number and a threshold number;

a complex adder for adding the divided complex data to obtain accumulated data and for obtaining an average value from the accumulated data;

a synchronization shift calculator for calculating a value of synchronization shift utilizing the average value; and

a synchronization timing estimation circuit for estimating a probable synchronization timing from the value of synchronization shift and for feeding back the synchronization timing to said complex data output device.

6. The receiving apparatus according to claim 5, wherein said complex data output device comprises:

a wavelet transformer including M real coefficient wavelet filters (M is a positive integer), which are orthogonal with respect to each other, for performing a wavelet transform of the received data;

a complex data generator for generating complex data by defining (2n-1)th outputs (n is a positive integer) from said wavelet transformer as in-phase components of complex information and 2n-th outputs ($1 \leq n \leq (M/2 - 1)$ and subcarriers

are numbered from 0 to M-1) from said wavelet transformer as orthogonal components of the complex information, and outputting parallel complex data; and

a parallel to serial converter for converting the parallel complex data outputted from said complex data generator to serial complex data and outputting the serial complex data.

7. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a wavelet transformer including M real coefficient wavelet filters (M is a positive integer), which are orthogonal with respect to each other, for performing a wavelet transform of the received data;

a complex data generator for generating complex data by defining (2n-1)th outputs (n is a positive integer) from said wavelet transformer as in-phase components of complex information and 2n-th outputs ($1 \leq n \leq (M/2 - 1)$ and subcarriers are numbered from 0 to M-1) from said wavelet transformer as orthogonal components of the complex information, and outputting parallel complex data;

a parallel to serial converter for converting the parallel complex data outputted from said complex data generator to serial complex data;

a delay element for delaying the serial complex data outputted by said parallel to serial converter for one sampling period and outputting delayed complex data;

a complex divider for dividing the serial complex data and the delayed complex data, and for outputting divided complex data, wherein the divided complex data expresses a phase difference between complex subcarriers;

a sign decision unit for performing a decision of a sign of both in-phase components of the divided complex data and orthogonal components of the divided complex data;

a plurality of counters for counting a number of each of the signs output from said sign decision unit;

a plurality of index buffers for storing n indexes ($1 \leq n \leq (M/2 - 1)$, subcarrier numbers vary from 0 to M-1) of the divided complex data corresponding to each of the signs output from said sign decision unit;

a maximal number detector for detecting a maximal number from the numbers output from said plurality of counters;

a selector for selecting indexes corresponding to the detected maximal number;

a decision unit for deciding whether the received data is intended data by comparing the maximal number and a threshold number;

a selector for selecting a part of the divided complex data corresponding to the selected indexes;

a complex adder for adding the divided complex data selected by said selector to obtain accumulated data and for obtaining an average value from the accumulated data;

a synchronization shift calculator for calculating a value of synchronization shift utilizing the average value; and

a synchronization timing estimation circuit for estimating a probable synchronization timing from the value of synchronization shift and for feeding back the synchronization timing to said complex data output device.

8. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a wavelet transformer for performing a wavelet transform of received data; and

a carrier detector for detecting a carrier from the received data;

wherein said wavelet transformer includes:

M-1 one-sample delay elements (M is positive integer more than 2) for delaying the received data sequentially for one sampling period;

M down samplers for down-sampling the received data and the sequentially delayed data;

a prototype filter having a polyphase configuration and possessing a real coefficient for receiving the down-sampled

data; and

M points fast Fourier transformer for performing a fast Fourier transform to the filtered data output from said prototype filter; and

wherein said carrier detector includes:

a one-symbol delay element for delaying the received data by one-symbol period;

an multiplier for multiplying the received data and the one-symbol delayed data; and

a one-symbol moving average circuit for receiving the added data and obtaining the moving average by correlating the received data with the delayed data.

9. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

an auto gain control circuit for automatically controlling a gain of received data;

a level decision unit for level deciding by comparing a gain level of data received from said auto gain control circuit and a threshold level;

an analog to digital converter for converting analog data output from said auto gain control circuit to digital data;

a carrier detector for deciding whether the digital data received from said analog to digital converter is intended data

based on the level decided by said level decision unit; and

a symbol synchronizing circuit for synchronizing the received data output from said carrier detector.

10. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a wave detecting portion for performing a wavelet transform to received data;

a carrier detection circuit for detecting a carrier utilizing data output from said wave detecting portion and a threshold which can be changed according to a condition of transmission line; and

a symbol synchronizing circuit for estimating synchronization timing utilizing data output from said carrier detection circuit.

11. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a wave detecting portion for performing a wavelet transform to received data;

a selector for selecting subcarriers according to a signal level of data output from said wave detecting portion;

a carrier detection circuit for performing a carrier

detection utilizing the subcarrier selected by said selector; and

a symbol synchronizing circuit for estimating synchronization timing utilizing the subcarrier selected by said selector.

12. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a wave detecting portion for performing a wavelet transform to received data;

a selector for selecting subcarriers according to a signal level of a gap between adjacent frames of data output from said wave detecting portion;

a carrier detection circuit for performing a carrier detection utilizing the subcarrier selected by said selector; and

a symbol synchronizing circuit for estimating synchronization timing utilizing the subcarrier selected by said selector.

13. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a first wave detecting portion for performing a wavelet

transform to received data;

a second wave detecting portion for performing a Fourier transform to received data;

a selector for selecting subcarriers according to a signal level of a gap between adjacent frames of data output from said second wave detecting portion;

a carrier detection circuit for performing a carrier detection utilizing the subcarrier selected by said selector; and

a symbol synchronizing circuit for estimating synchronization timing utilizing the subcarrier selected by said selector.

14. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a first wave detecting portion for performing a wavelet transform to received data;

a second wave detecting portion for performing a Fourier transform to received data;

a selector for selecting subcarriers according to a signal level of a gap between adjacent frames of data output from said second wave detecting portion;

a carrier detection circuit for performing a carrier detection utilizing the subcarrier selected by said selector;

and

a symbol synchronizing circuit for estimating synchronization timing utilizing the data output from said first wave detecting portion.

15. The receiving apparatus according to claim 13, wherein both of said first wave detecting portion and said second wave detecting portion share a common fast Fourier transformer.

16. A receiving apparatus employing a digital multi-carrier transmission method, said apparatus comprising:

a data transforming device for transforming received data to transformed data utilizing a wavelet transform;

a delay element for producing delayed data by delaying the transformed data;

a subcarrier-pair generating device for generating a subcarrier pair from the transformed data and the delayed data;

a phase-difference calculator for calculating a phase-difference between subcarrier-pairs; and

a decision unit for deciding received data based on the phase-difference calculated by said phase-difference calculator.

17. The apparatus according to claim 14, wherein both of said first wave detecting portion and said second wave detecting

portion share a common fast Fourier transformer.

18. A receiving apparatus employing a digital multi-carrier transmission method utilizing a real coefficient wavelet filter bank, said apparatus comprising:

a complex data output means for performing a wavelet transform of received data and outputting complex data;

a delay means for delaying the complex data for one sampling period and outputting delayed complex data;

a dividing means for dividing the complex data and the delayed complex data, and for outputting divided complex data, wherein the divided complex data expresses a phase difference between complex sub-carriers;

a calculation means for calculating a number of the divided complex data present within each of plural quadrants on orthogonal coordinates and selecting a maximal number among the calculated numbers; and

a decision means for deciding whether the received data is intended data by comparing the maximal number and a threshold number.

19. The receiving apparatus according to claim 18, wherein said complex data output means comprises:

M real coefficient wavelet filtering means (M is a positive integer), which are orthogonal with respect to each

other, for performing a wavelet transform of the received data;

a complex data generating means for generating complex data by defining (2n-1)th outputs (n is a positive integer) from said wavelet filtering means as in-phase components of complex information and 2n-th outputs ($1 \leq n \leq (M/2 - 1)$ and sub-carriers are numbered from 0 to M-1) from said wavelet filtering means as orthogonal components of the complex information, and outputting parallel complex data; and

a converting means for converting the parallel complex data output from said complex data generating means to serial complex data and outputting the serial complex data.

20. The receiving apparatus according to claim 18, wherein said calculation means comprises:

a shifting means for shifting a phase of the divided complex data by $\pi/4$;

a decision means for performing a decision of a sign of the divided complex data;

a counting means for counting a number of divided complex data points distributed to each of the plural quadrants and outputting the counted numbers; and

a detecting means for detecting the maximal number among the counted numbers outputted from said plurality of counting means.

21. The receiving apparatus according to claim 18, wherein said calculation means comprises:

a decision means for performing a decision of a sign of both in-phase components of the divided complex data and orthogonal components of the divided complex data;

a counting means for counting a number of each of the signs output from said decision means and outputting the counted numbers; and

a detecting means for detecting a maximal number among the counted numbers outputted from said counting means.

22. A method for receiving data from a digital multi-carrier transmission utilizing a real coefficient wavelet filter bank, said method comprising:

performing a wavelet transform of received data and outputting complex data;

delaying the complex data for one sampling period and outputting delayed complex data;

dividing the complex data and the delayed complex data, and outputting divided complex data, wherein the divided complex data expresses a phase difference between complex sub-carriers;

calculating a number of the divided complex data present within each of plural quadrants on orthogonal coordinates and selecting a maximal number among the calculated numbers; and

deciding whether the received data is intended data by comparing the maximal number and a threshold number.

23. The method according to claim 22, wherein said performing wavelet transform of received data and outputting complex data comprises:

performing a wavelet transform of the received data using M real coefficient wavelet filters (M is a positive integer) which are orthogonal with respect to each other;

generating complex data by defining (2n-1)th outputs (n is a positive integer) from the wavelet filters as in-phase components of complex information and 2n-th outputs ($1 \leq n \leq (M/2 - 1)$ and sub-carriers are numbered from 0 to M-1) from the wavelet filters as orthogonal components of the complex information, and outputting parallel complex data; and

converting the parallel complex data output from said generating to serial complex data and outputting the serial complex data.

24. The method according to claim 22, wherein said calculating comprises:

shifting a phase of the divided complex data by $\pi/4$;

performing a decision of a sign of the divided complex data;

counting a number of divided complex data points

distributed to each of the plural quadrants and outputting the counted numbers; and

detecting the maximal number among the counted numbers outputted in said counting.

25. The method according to claim 22, wherein said calculating comprises:

performing a decision of a sign of both in-phase components of the divided complex data and orthogonal components of the divided complex data;

counting a number of each of the signs output in said performing decision and outputting the counted numbers; and

detecting a maximal number among the counted numbers outputted in said counting.